ISSN: 0976-3376

Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 07, Issue, 05, pp.3015-3017, May, 2016

RESEARCH ARTICLE

SPECIAL PAIRS OF RECTANGLES AND JARASANDHA NUMBERS

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ARTICLE INFO

Article History:
Received 24th February, 2016
Received in revised form
16th March, 2016
Accepted 21st April, 2016
Published online 30th May, 2016

Key words:

Pairs of rectangles,
Jarasandha numbers.

ABSTRACT

We present pairs of rectangles, such that in each pair, the sum of their areas equals the Jarasandha number. Also we present the number of pairs of primitive and non-primitive rectangles.

INTRODUCTION

Mathematics is the language of patterns and relationships, and is used to describe anything that can be quantified. Number theory is one of the largest and oldest branches of mathematics. The main goal of number theory is to discover interesting and unexpected relationships. It is devoted primarily to the study of natural numbers and integers. In number theory, rectangles have been a matter of interest to various mathematicians, because it is a treasure house in which the search for many hidden connection is a treasure hunt. For an extensive variety of fascinating problems, one may refer (Sierpinski, 2003; Gopalan and Vijayasankar, 2010; Gopalan, 2007; Gopalan and Gnanam, 2010 and Gopalan and G. Janaki, 2008). Apart from the polygonal numbers, we have some more fascinating patterns of numbers namely Jarasandha numbers, nasty numbers and dhuruva numbers. These numbers have been presented in (Kapur, 1997; Bert Miller, 1980; Charles Bown, 1981 and Sastry, 2001). In (Gopalan and Janaki, 2008) special pythagorean triangles connected with nasty numbers are obtained. In (Janaki and Vidhya, 2016), rectangle in which area is represented as a special polygonal number are given. In (Janaki and Saranya, 2016), special pythagorean triangles connected with Jarasandha numbers are obtained. In (Janaki and Saranya, 2016), special pairs of pythagorean triangles and Jarasandha numbers are presented. Recently in (Janaki and Saranya, 2016), rectangles in connection with Jarasandha numbers are obtained.

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In this communication, we search for pairs of rectangles, such that in each pair, the sum of their areas equals the Jarasandha number. Also we present the number of pairs of primitive and non-primitive rectangles.

Definition

A rectangle is said to be primitive if u, v are of opposite parity and $\gcd(u, v) = 1$, where $x = u + v, y = u - v$ & $u > v > 0$.

Jarasandha Numbers

In our Indian epic Mahabharata, we come across a person named 'JARASANDHA'. He had a boon that if he was split into two parts and thrown apart, the parts would rejoin and return to life. In fact, he was given life by the two halves of his body. In the field of mathematics, we have numbers exhibiting the same property as Jarasandha Consider a number of the form XC. This may split as two numbers X and C and if these numbers are added and squared we get the same number XC. (i.e) $XC = (X+C)^2 = XC$

Note: If C is an n-digit number, then $(X+C)^2 = (10^n)(X) + C$

MATERIALS AND METHOD

Let R_1, R_2 be two distinct rectangles with dimensions x and y, where $x = u + v, y = u - v$ and z and t, where

$z = w + v, t = w - v$, $(u > w > v > 0)$ respectively. Let A_1, A_2 be the areas of R_1, R_2 such that

$A_1 + A_2$ = Jarasandha number.

The above relation leads to the equation

$u^2 + w^2 - 2v^2 =$ Jarasandha number. (1)

Case 1

When $u^2 + w^2 - 2v^2 = 81$(2-digit Jarasandha number) (2)

After performing numerical computations, it is noted that there are 2 distinct values for u, v, w satisfying (2). For simplicity and clear understanding, we have presented the values of u, v, w, A_1 and A_2 in Table 1 as below.

Table 1.

S.NO.	u	v	w	A_1	A_2	$A_1 + A_2$
1.	8	2	5	60	21	81
2.	8	4	7	48	33	81

Thus, it is seen that there are 2-pairs of rectangles for the Jarasandha number 81. For both of the 2-pairs of rectangles, one of the rectangle is primitive and the other is a non-primitive rectangle.

Case 2

Consider the 4-digit Jarasandha number 2025,

$\therefore$ (1) $\Rightarrow u^2 + w^2 - 2v^2 = 2025$ (3)

Following the same procedure as in case1, we have 10 distinct values for u, v, w satisfying (3). For simplicity and clear understanding, we have presented the values of u, v, w, A_1 and A_2 in *Table 2* as below.

Table 2.

S.NO.	u	v	w	A_1	A_2	$A_1 + A_2$
1.	52	32	37	1680	345	2025
2.	49	34	44	1245	780	2025
3.	48	30	39	1404	621	2025
4.	47	22	28	1725	300	2025
5.	44	4	11	1920	105	2025
6.	44	10	17	1836	189	2025
7.	40	20	35	1200	825	2025
8.	40	10	25	1500	525	2025
9.	39	6	24	1485	540	2025
10.	37	8	28	1305	720	2025

Thus, it is seen that there are 10-pairs of rectangles such that for each pair, the sum of their areas equals the Jarasandha number 2025. Out of these 10-pairs of rectangles, 4-pairs are non-primitive and in each of the remaining 6-pairs, one of the rectangle is primitive and the other is non-primitive rectangle.

Case 3

Consider the 4-digit Jarasandha number 3025,

For this choice, we have, $u^2 + w^2 - 2v^2 = 3025$ (4)

Following the same procedure as in case1, we have 6 distinct values for u, v, w satisfying (4). For simplicity and clear understanding, we have presented presented the values of u, v, w, A_1 and A_2 in Table 3 as below.

Table 3.

S.NO.	u	v	w	A_1	A_2	$A_1 + A_2$
1.	64	36	39	2800	225	3025
2.	60	30	35	2700	325	3025
3.	57	20	24	2849	176	3025
4.	48	20	39	1904	1121	3025
5.	48	18	37	1980	1045	3025
6.	48	2	27	2300	725	3025

Thus, it is seen that there are 6-pairs of rectangles for the Jarasandha number 3025. Out of these 6-pairs of rectangles, 3-pairs are non-primitive and in each of the remaining 3-pairs, one of the rectangle is primitive and the other is non-primitive rectangle.

Case 4

Consider the 4-digit Jarasandha number 9801, For this choice, we have,

$u^2 + w^2 - 2v^2 = 9801$ (5)

Following the same procedure as in case1, we have 24 distinct values for u, v, w satisfying (5). For simplicity and clear understanding, we have presented presented the values of u, v, w, A_1 and A_2 in Table 4 as below.

Table 4.

S.NO.	u	v	w	A_1	A_2	$A_1 + A_2$
1.	127	86	92	8733	1068	9801
2.	124	80	85	8976	825	9801
3.	120	78	87	8316	1485	9801
4.	108	54	63	8748	1053	9801
5.	107	56	68	8313	1488	9801
6.	105	42	48	9261	540	9801
7.	100	32	43	8976	825	9801
8.	100	28	37	9216	585	9801
9.	97	46	68	7293	2508	9801
10.	97	34	52	8253	1548	9801
11.	97	14	28	9213	588	9801
12.	97	2	20	9405	396	9801
13.	95	50	76	6525	3276	9801
14.	95	2	28	9021	780	9801
15.	93	24	48	8073	1728	9801
16.	92	16	43	8208	1593	9801
17.	92	4	37	8448	1353	9801
18.	88	44	77	5808	3993	9801
19.	88	22	55	7260	2541	9801
20.	87	6	48	7533	2268	9801
21.	85	40	76	5625	4176	9801
22.	85	32	68	6201	3600	9801
23.	85	8	52	7161	2640	9801
24.	76	10	65	5676	4125	9801

Thus, it is seen that there are 24-pairs of rectangles such that for each pair, the sum of their areas equals the Jarasandha number 9801. Out of these 24-pairs of rectangles, 10-pairs are non-primitive and in each of the remaining 14-pairs, one of the rectangle is primitive and the other is non-primitive rectangle.

Conclusion

To conclude, One may search for the connections between the pairs of rectangles and other Jarasandha numbers of higher order and other number patterns.

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